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Original Research

Effects of intravenous lidocaine or topical lidocaine applied before upper gastrointestinal endoscopy on hemodynamics and throat pain

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Abstract

Aim: Upper gastrointestinal endoscopy is commonly performed as an outpatient procedure, which may lead to overlooking potential arrhythmias. In this study, we aimed to investigate the effects of intravenous or topical lidocaine on hemodynamics, QT interval and throat pain in patients scheduled for upper gastrointestinal endoscopy.

Material and Methods: The patients were randomly divided into three groups: Group I received 1 mg/kg IV(ıntravenous) propofol induction, Group II received 1 mg/kg IV propofol induction and topical lidocaine (9 sprays, 3 sprays at 10-second intervals, totaling 90 mg), and Group III received 1 mg/kg IV propofol induction and 1.5 mg/kg IV lidocaine induction. ECGs(Electrocardiogram) were obtained before and after the procedure, and hemodynamic data were recorded. Throat pain in patients was assessed after the procedure.

Results: There was a statistically significant difference in systolic blood pressure (SBP) values at the 3rd minute among the three groups (p=0.021). The SBP values at the 3rd and 5th minutes in Group I were significantly lower compared to Groups II and III (p=0.021, p=0.012 retrospectively). There was a statistically significant difference in diastolic blood pressure (DBP) values among the three measurements in Group I (p=0.0001). The DBP values at 1 minute in Group I were significantly higher compared to the values at the 3rd and 5th minutes. Additionally, there was a statistically significant difference in postoperative QTc values among the groups (p=0.001).

Discussion: We concluded that 1.5 mg/kg IV lidocaine effectively suppressed the hemodynamic response secondary to adrenergic activation during upper gastrointestinal endoscopy and also suppressed the increase in QT and QTc values.

Keywords

IV Lidocaine, Topical Lidocaine, Qt Interval

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Introduction

In laryngoscopy and intubation procedures, manipulation of the upper airway can stimulate the sympathetic nervous system and result in an increase in blood pressure (BP) and heart rate (HR), potentially leading to arrhythmias. The increase in HR imposes a greater workload on the heart compared to the increase in BP. Tachycardia increases myocardial oxygen (O2) consumption while also reducing diastolic filling, which can impede effective coronary blood flow. This response can lead to life-threatening complications [1]. To mitigate these unwanted effects, deepening general anesthesia or administering topical lidocaine or 1.5 mg/kg intravenous (IV) lidocaine before the procedure is recommended [2].

The QT interval on an electrocardiogram (ECG) represents the period of ventricular depolarization and repolarization, signifies the refractory period of the ventricular muscle. It varies with heart rate; as heart rate increases, the QT interval shortens. The QT interval corrected for heart rate is referred to as QTc. QT dispersion (QTd) is the difference between the longest and shortest QT intervals measured on a twelve-lead ECG. Prolongation of perioperative QTd and QTc intervals can result in serious arrhythmias such as ventricular tachycardia, ventricular fibrillation, and cardiac arrest [3,4].

Upper gastrointestinal (GI) endoscopy [esophagogastroduodenoscopy (OGD)] is typically performed as an outpatient procedure, which may lead to overlooking potential post-discharge arrhythmias. Changes in QTc can serve as an early indicator for these arrhythmias. Studies investigating the effects of local or IV lidocaine administration in treating post-intubation arrhythmias exist. We believe that similar sympathetic stimulation due to manipulation can lead to arrhythmias following OGD. However, in the literature, we have not found a study specifically examining the effects of IV or topical lidocaine on the QT interval in relation to arrhythmias presumed to be associated with OGD. Inspired by this, in this study we have investigated the effects of IV or topical lidocaine administered to patients undergoing OGD on hemodynamics, presence of throat pain, and QT interval.

Material and Methods

Patients aged 18 to 65 who underwent upper gastrointestinal endoscopy at Pamukkale University Faculty of Medicine Hospital between January 1, 2017, and February 28, 2017 included in the study. The study received approval from the Non-Interventional Clinical Research Ethics Committee with decision No. 07.03.2017/04.

All patients were evaluated preoperatively, and verbal and written consent was obtained after providing information about the anesthesia method to be applied. Anesthesia procedures were standardized for each patient. No sedation was applied to the patients before the procedure. In the procedure room, patients were monitored with 12-lead ECG, blood pressure (BP), and peripheral oxygen saturation (SpO2) using a nasal cannula delivering 2L/min of O2. Before the procedure, a 12-lead ECG (Cardioline, ar1200view, Italy) was obtained from the patients. The demographic characteristics of the patients and their American Society of Anesthesiologists physical status classification (ASA scores) were recorded.

Exclusion Criteria

Patients with a heart rate <50/min or >100/min, those using cardiovascular system affecting drugs (beta blockers, calcium channel blockers, diltiazem, etc.), those using sedative or opioid drugs, those with allergies to propofol and lidocaine, those who are pregnant or lactating, those with BP <90/60 or >180/100, and patients with long QT syndrome were excluded from the study.

The patients were randomly divided into three groups as follows:

- Group I: 1 mg/kg IV propofol (Propofol, Fresenius Kabi İlaç Sanayi ve Tic AŞ, Spain) induction,
- Group II: 1 mg/kg IV propofol induction and topical lidocaine (Vemcaine, VEM İlaç San ve Tic AŞ, Tekirdağ) with 3 sprays at 10-second intervals (9 puffs - 90 mg),
- Group III: 1 mg/kg IV propofol induction and 1.5 mg/kg IV lidocaine (Aritmal, Osel Drug Industry and Trade, Istanbul) induction.

Peripheral venous access was established with a 22-gauge cannula in the enrolled patients. Propofol induction was started with 1 mg/kg and additional bolus doses of 0.5 mg/kg were administered as needed. During the endoscopy procedure, the patients' BP, systolic blood pressure (SBP), diastolic blood pressure (DBP), and SpO2 data were monitored, and another ECG was obtained after the procedure. ECG recordings were obtained at a speed of 25 mm/s, and changes in the QT interval were evaluated by comparing the initial and final ECGs. Manual measurements were taken for the QT interval in each lead. The starting point of the QRS wave and the point where the T wave intersected the isoelectric line were taken as the reference points for the QT interval. In cases where this point was not clearly defined and the T wave ended where it intersected with a U wave, the lowest point of the curve between the T and U waves was taken as the end point of the T wave. Awakening criteria were assessed based on eye opening, tongue protrusion, and hand squeezing durations. After the procedure, patients were asked if they had any throat pain.

Statistical Analysis

The data were analyzed using SPSS 18 (SPSS Inc, Chicago, IL, USA) software. Continuous variables were expressed as mean ± standard deviation, median (minimum and maximum values), and categorical variables were expressed as numbers and percentages. The normal distribution of the examined variables was assessed using the Shapiro-Wilk test. When the assumptions of the parametric tests were met, One-Way Analysis of Variance was used to compare independent group differences, and when the assumptions of parametric tests were not met, the Kruskal-Wallis Analysis of Variance was used. In dependent group comparisons, when the assumptions of parametric tests were met, Repeated Measures Analysis of Variance and significance testing of the difference between two means were used, and when the assumptions of parametric tests were not met, the Friedman Test and Wilcoxon Signed-Rank Test were used. Differences between categorical variables were examined using the Chi-square test. A p-value of <0.05 was considered statistically significant in all analyses.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

The average age of the 90 patients participating in the study was found to be 47.8±14.92, with an average weight of 74.13±16.93. There were no statistically significant differences between the groups in terms of average age (p=0.228), average weight (p=0.272), gender distribution (p=0.801), and ASA risk classification (p=0.712). The demographic data of the patients according to the groups are presented in Table 1.

When the hemodynamic measurements were examined according to the groups, there was no statistically significant difference between the groups in terms of 1st, 3rd, and 5th-minute cardiac output (KAH) values. There was no significant difference in 1st-minute cardiac index (SBP) values between the groups (p=0.07). There was a statistically significant difference in SBP values at 3rd minute (p=0.021) among the three groups. Group I had significantly lower SBP values at the 3rd minute compared to Group II and III. There was a statistically significant difference in SBP values at the 5th minute (p=0.012) among the three groups. Group I had significantly lower SBP values at the 5th minute compared to Group II and III. There was a statistically significant difference in SBP values within Group I (p=0.018) among the three measurements. Group I had significantly higher SBP values at 1st minute compared to 3rd and 5th minute values. There was a statistically significant difference in SBP values within Group II (p=0.0001) among the three measurements. Group II had significantly higher SBP values at 1st minute compared to 3rd and 5th minute values. There was a statistically significant difference in SBP values within Group III (p=0.0001) between the three measurements. Group III had significantly higher SBP values at 1st minute compared to 3rd and 5th minute values.

There was no statistically significant difference in 1st-minute DBP, 3rd-minute DBP, and 5th-minute DBP values between the groups. There was a statistically significant difference in DBP values within Group I (p=0.0001) between the three measurements. Group I had significantly higher DBP values at 1st minute compared to 3rd and 5th minute values. There was a statistically significant difference in DBP values within Group II (p=0.0001) among the three measurements. Group II had significantly higher DBP values at 1st minute compared to 3rd and 5th minute values. There was no statistically significant difference in DBP values within Group III (p=0.154). The hemodynamic measurements of the patients according to the groups are presented in Table 2.

When comparing hemodynamic values between groups, no statistically significant difference was found. However, it was observed that in Group III, hemodynamic values were clinically more stable. Hemodynamic parameter measurements between groups were compared. There was no significant difference between groups in SpO2 values at 1 minute (p=0.205) and 3 minutes (p=0.093), but a significant difference was observed in SpO2 values at 5 minutes (p=0.05). Although there was a statistically significant difference in SpO2 values within each group (Group I: p=0.009, Group II: p=0.018, Group III: p=0.0001), no respiratory problems requiring intervention were encountered in any of the patients during the endoscopy procedure. In the intergroup comparison, there was no statistically significant difference between preoperative QT (p=0.388) and postoperative QT (p=0.056) values, as well as preoperative QTc (p=0.156) values. However, a significant difference was detected in postoperative QTc values (p=0.0001). In Group I, preoperative QT values were significantly lower compared to postoperative QT values (p=0.0001), and similarly, preoperative QTc values were significantly lower compared to postoperative QTc values (p=0.0001). No statistically significant difference was found in preoperative QT, postoperative QT, preoperative QTc, and postoperative QTc values in Group II. In Group III, while there was no statistically significant difference between preoperative QT values and postoperative QT values, preoperative QTc values were found to be significantly higher compared to postoperative QTc values (p=0.004) (Table 3).

Table 1. Demographic data of the patients.

	Group I Mean ±SD	Group II Mean ±SD	Group III Mean ±SD	P value
Age	47,8 ± 14,92	45,2± 13,37	50,43±13,34	0,228
Weight	74,13±16,93	76,7±12,09	72,67±15,04	0,272
Sex F/M	21.9	23.7	21.9	0,801
	(%70/%30)	(%76,7/%23,3)	(%70/%30)	
ASA physical status 1/2/3	2/18/0	9/ 21/0	12/17/1	0,712
	(%40/%60)	(%30/% 70)	(% 40/% 56,67/% 3,33)	

SD, standard deviation; ASA, American Society of Anesthesiologists Physical Status Classification System; F, Female; M, Male. P values <.05 were considered statistically significant.

Table 2. Hemodynamic measurements of patients (HR, SBP, DBP).

	Group I Mean ±SD	Group II Mean ±SD	Group III Mean ±SD	P- value between groups
HR 1 min	82,43±11,69	88,07±14,11	84,9±17,05	0,323
HR 3 min	82,1±9,78	83,53±13,46	81,77±11,54	0,99
HR 5 min	81,07±9,27	84,87±11,4	81,63±12,63	0,369
P- value within-group	0,547	0,27	0,187	
SBP 1 min	130,37±20,97	139,43±19,31	141,7±19,15	0,07
SBP 3 min	118,5±20,25	125,1±18,76	132,03±18,44	0,021
SBP 5 min	119,17±15,25	124,97±13,1	130,97±16,27	0,012
P- value within-group	0,018	0,0001	0,0001	
DBP 1 min	80,07±12,25	84,97±11,32	85,63±12,46	0,326
DBP 3 min	73,93±14,51	79,37±10,8	80,3±10,31	0,092
DBP 5 min	76,17±11,17	81,43±9,8	83,2±12,49	0,109
P- value within-group	0,0001	0,0001	0,154	

SD, standard deviation; HR, heart rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; Min, minute; P values <.05 were considered statistically significant.

Table 3. Evaluation of QT and QTc interval according to the groups.

	Group I Mean ±SD	Group II Mean ±SD	Group III Mean ±SD	P- value between groups
Preoperative QT	358,67±35,6	368±32,21	374,33±44,23	0,388
Postoperative QT	390,67±34,33	380±36,01	374±62,4	0,056
P -value within-group	0,0001	0,088	0,414	
Preoperative QTc	404,27±34,39	421,13±39,85	421,97±44,19	0,156
Postoperative QTc	448,07±33,48	430,9±43,84	406,27±53,18	0,0001
P- value within-group	0,0001	0,329	0,004	

SD, standard deviation; Qtc, corrected QT interval. P values <.05 were considered statistically significant.

Postoperative recovery results were examined after endoscopy. Significant differences were found between groups in terms of eye opening (p=0.032), tongue protrusion (p=0.032), and hand squeezing (p=0.032) durations, which were evaluated as awakening criteria. Postoperative throat pain was observed in 5 patients in Group I, 1 patient in Group II, and 4 patients in Group III, but no statistically significant difference was found between the groups (p=0.180).

Discussion

In this study, the effects of intravenous lidocaine or topical lidocaine administered to patients prior to OGD on hemodynamics, changes in QTc interval, and throat pain were investigated. It has been reported that the induction period, laryngoscopy, tracheal intubation, and inadequate anesthesia during anesthesia administration can lead to sympathetic-adrenal activity increase and consequently prolongation of the QT interval, even in patients without cardiac problems [5]. Abnormal QT interval can potentially cause life-threatening ventricular tachyarrhythmias. QT interval control is an important hemodynamic parameter that needs to be monitored to prevent sudden changes and unwanted cardiovascular responses in SBP and DBP, which can lead to myocardial ischemia in the postoperative period. It has been stated that HR is an important hemodynamic parameter that affects myocardial oxygen consumption. It has been reported that hemodynamic parameters are more affected during periods of increased sympathetic discharge during anesthesia administration. [6]

Various anesthesia techniques and drugs are available to prevent and minimize hemodynamic responses to laryngoscopy and intubation. The choice of drug or method depends on several factors, including the duration and type of surgery, the anesthesia technique to be applied, the route of drug administration, the patient's medical condition, and personal preference. The ideal drug to be used for this purpose should have a rapid onset of action, be reliable, be easy to prepare and use, and have an appropriate duration of action for its purpose [7]. Currently, narcotic analgesics, lidocaine, vasodilators such as nitroglycerin and sodium nitroprusside, calcium channel blockers, beta blockers, ganglion blockers, and alpha-2 agonists are used to reduce and prevent hemodynamic responses [8]. In the existing literature, we have come across many studies investigating the effects of anesthetic drugs on hemodynamic responses during intubation [9-10]. However, there are very few studies on the hemodynamic response and the effects of lidocaine during upper gastrointestinal endoscopy performed without endotracheal intubation, and most of them are associated with respiratory symptoms. In our study, we investigated the effects of puff lidocaine and IV lidocaine administered during endoscopy on the potential hemodynamic response.

In a study conducted by Kiaee et al., they administered magnesium and lidocain before induction, and they showed that magnesium provided better hemodynamic response during tracheal intubation [11]. In our study, the hemodynamic response was better in the IV lidocaine group compared to the puff lidocaine group

Helfman et al. conducted a randomized, double-blind study to investigate the effect of lidocaine, fentanyl and esmolol to hemodynamic parameters. The esmolol group was found to be more effective, consistent, and reliable in preventing SBP and DBP values associated with laryngoscopy and tracheal intubation compared to fentanyl and lidocaine [12]. Levitt et al. found in their study that 2 mg/kg of lidocaine and 2 mg/kg of esmolol similarly suppressed hemodynamic responses in head trauma patients [13]. In our study, even though the IV lidocaine dose was 1.5 mg/kg, we concluded that hemodynamic responses were sufficiently suppressed. Kindler et al. compared two different doses of esmolol with lidocaine in a randomized, double-blind, placebo-controlled study [14]. They divided 90 patients with ASA physical scores I and II, scheduled for elective gynecological surgery under general anesthesia, into six groups. Only the placebo group had higher heart rates compared to the baseline. Systolic blood pressure was lower in the groups where esmolol and lidocaine combinations were used compared to pre-intubation values. In all other groups, systolic blood pressure values were similar to pre-intubation values. Consequently, only the groups containing esmolol and lidocaine combinations were found to be successful in preventing hemodynamic responses to intubation and laryngoscopy. In our study, heart rate values were similar in all groups, and changes from baseline were not statistically significant. SBP values were suppressed only in the IV lidocaine group.

Plazon et al. conducted studies by administering 1.5 mg/kg of lidocaine or 0.4 mg/kg of urapidil before laryngoscopy [15]. They showed that both agents prevented the increase in arterial pressure but were insufficient in preventing an increase in SBP. In our study, no hypertension was observed in any of the patients. Although there were 10-15 mmHg decreases in SBP and DBP values at the 3rd minute in all groups, no patient required intervention, and the patients' measurements at the 5th minute returned to pre-procedure values.

Measuring the QT interval is a challenging calculation. Neither manual nor automatic measurement methods are entirely accurate. Antzelevitch et al. found manual measurement to be more reliable than automatic measurement and reported that during automatic measurement, incorrect results were found in 50% of cases when compared to manual measurement. As the number of ECG derivations increases, the reliability of QT assessment will improve [16]. In our study, manual measurement was applied, and each measurement was performed by the same person to increase the reliability of our study, and we performed a 12-lead ECG measurement.

In studies conducted with propofol, it has been found that the duration between the end of the T wave and the highest level of the T wave was prolonged, but interestingly, the arrhythmogenic effect of propofol could not be demonstrated. Whyte et al. reported in a study with propofol that this drug could be safely used even in children with prolonged QT syndrome. In studies conducted with inhalation anesthetics and propofol, especially with the use of propofol at a dose of 0.2-5 mg/kg for induction, the relationship between QT duration and these drugs has been investigated. It has been shown that this dose range does not prolong QT, and propofol is emphasized to be very safe in patients with prolonged QT [17-18]. In a study investigating the effect of target-controlled propofol

infusion on the QTc interval, it was determined that QTc values increased significantly compared to baseline during propofol infusion and endotracheal intubation. However, the researchers reported that they did not detect any arrhythmia during the study and that the prolongation of the QTc interval was not clinically significant [19]. Based on these studies, we preferred the use of propofol for sedation purposes in patients undergoing endoscopy. Paventi et al. have reported that propofol shortens the QT interval [20]. In our study, we observed that propofol did not prevent the prolongation of the QT interval.

In our study, preoperative and postoperative QT intervals and QTc intervals were compared between groups. According to the comparison of preoperative QT and postoperative QT values between groups, it was concluded that there was an elongation in the control group and the group receiving puff lidocaine, while there was no elongation in the IV lidocaine group. Although there was elongation in postoperative QT values, it may not be correctly interpreted due to changes in patients' heart rates. While QTc prolongation was not prevented in groups using propofol and puff lidocaine, it was observed that there was no elongation in postoperative QTc values in the IV lidocaine group. In a study by Sılay et al., the effects of spraying benzidamine and lidocaine before upper gastrointestinal endoscopy on taste perception, coughing, and gag reflex were investigated. They found that benzidamine was not superior to lidocaine in terms of general patient tolerance, but benzidamine could be preferred in difficult intubations or in patients with a history of throat pain after upper GI procedures [21]. In our study, postoperative throat pain was observed in 5 patients in Group I, 1 patient in Group II, and 4 patients in Group III. Despite no significant difference between the groups, we attribute the lower incidence of throat pain in Group II to the local anesthetic effect of the puff used. None of our patients experienced respiratory problems requiring intubation during the procedure or in the first hour after the procedure. No cardiac arrhythmias were observed in any of the patients during the procedure or in the first hour afterward. Therefore, we believe that all three methods can be safely used.

Conclusion

In this study comparing the effects of puff lidocaine and IV lidocaine on hemodynamic changes and throat pain during upper gastrointestinal endoscopy; puff lidocaine is more effective in suppressing the hemodynamic response secondary to adrenergic activation during upper GI endoscopy, IV lidocaine is effective in suppressing the increase in QT and QTc values and puff lidocaine is sufficient in relieving throat pain. The findings of this research underscore the imperative for further in-depth exploration in this field.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of interest

The authors declare no conflict of interest.

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